CLAIMS

We claim:

1. A method for in line, real-time processing and monitoring of a semiconductor wafer comprising:

creating a plurality of electron-hole pairs near a surface of the wafer; and

heating the wafer to substantially desorb any contaminant adsorbed on the surface of the wafer.

2. The method of claim 1 wherein creating a plurality of electron-hole pairs comprises illuminating the wafer with radiation sufficient to create a plurality of electron-hole pairs near the surface of the wafer.

3. The method of claim 2 wherein heating the wafer comprises illuminating the wafer with a near infrared radiation.

4. The method of claim 2 wherein heating the wafer comprises placing the wafer on a hot surface.

5. The method of claim 2 further comprising automatically controlling intensity and duration of heating and illuminating steps.

6. The method of claim 2 further comprising measuring a temperature of the wafer during the heating step and controlling intensity and duration of heating and illuminating steps based on the measured temperature.

7. The method of claim 2 wherein the wafer is heated and illuminated until a stable surface condition is achieved.

8. The method of claim 1 wherein heating comprises heating the substrate to a temperature in the range from about 200 °C to about 300 °C.

9. The method of claim 3 wherein illuminating with a near infrared radiation comprises illuminating with light having a wavelength in the range from about 0.2 microns to about 0.4 microns.

10. The method of claim 2 further comprising cooling the wafer after heating and illuminating the wafer.

11. The method of claim 2 wherein the wafer is a p-type wafer and heating and illuminating the wafer restores an inversion layer at the surface of the p-type wafer.

12. The method of claim 2 wherein the wafer is a p-type wafer and heating and illuminating the wafer activates dopants previously deactivated due to interactions with contaminant ions.

13. The method of claim 1 further comprising:

illuminating a portion of the wafer with a modulated light; and

measuring an electrical characteristic of the wafer.

14. The method of claim 13 wherein measuring an electrical characteristic comprises measuring a photovoltage induced at the surface of the wafer.

15. The method of claim 14 further comprising calculating a carrier lifetime from the measured surface photovoltage.

16. The method of claim 14 further comprising determining a conductivity type from the measured surface photovoltage.

17. The method of claim 14 further comprising determining a doping concentration from the measured surface photovoltage.

18. An apparatus for surface treating a semiconductor wafer comprising:

a surface treatment chamber; and

a source of radiation illuminating a semiconductor wafer disposed inside the chamber with a radiation sufficient to create a plurality of electron-hole pairs near a surface of the wafer and to desorb any contaminant adsorbed on the surface of the wafer.

19. The apparatus of claim 18 wherein the surface treatment chamber is integrated with an in-line, real-time testing apparatus, such that electrical characteristics of the wafer can be measured.

20. The apparatus of claim 19 wherein a surface photovoltage of the wafer is measured after the wafer has been surface treated.

21. The apparatus of claim 18 wherein the source of radiation comprises a tungsten halogen quartz lamp.

22. The apparatus of claim 18 further comprising a plurality of reflectors disposed inside the surface treatment chamber to provide uniform illumination of the wafer.

23. The apparatus of claim 18 further comprising a power control circuitry for controlling an intensity of radiation from the radiation source.

24. The apparatus of claim 18 further comprising a temperature sensor for monitoring radiation from the wafer during surface treatment.

25. The apparatus of claim 18 further comprising a filter disposed between the radiation source and the wafer for filtering radiation having wavelength greater than about 4 microns.

26. The apparatus of claim 18 further comprising a first filter disposed between the radiation source and the wafer, a second filter disposed adjacent the first filter, and an air passageway disposed between the first filter and the second filter for cooling the filters, wherein the first filter and the second filter prevents radiation having wavelengths greater than about 4 microns from reaching the wafer.